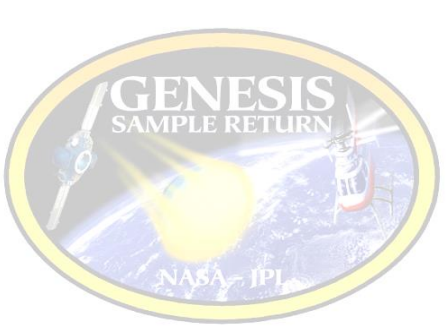
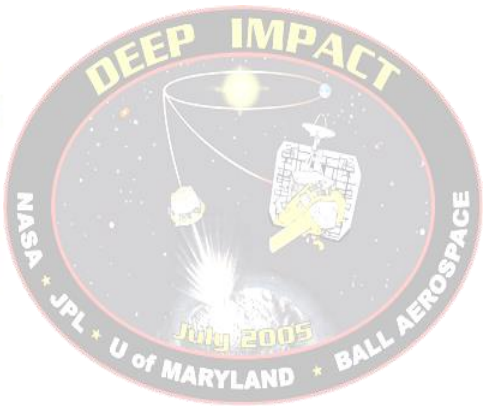


Expendable Launch Vehicle Payload Safety Program

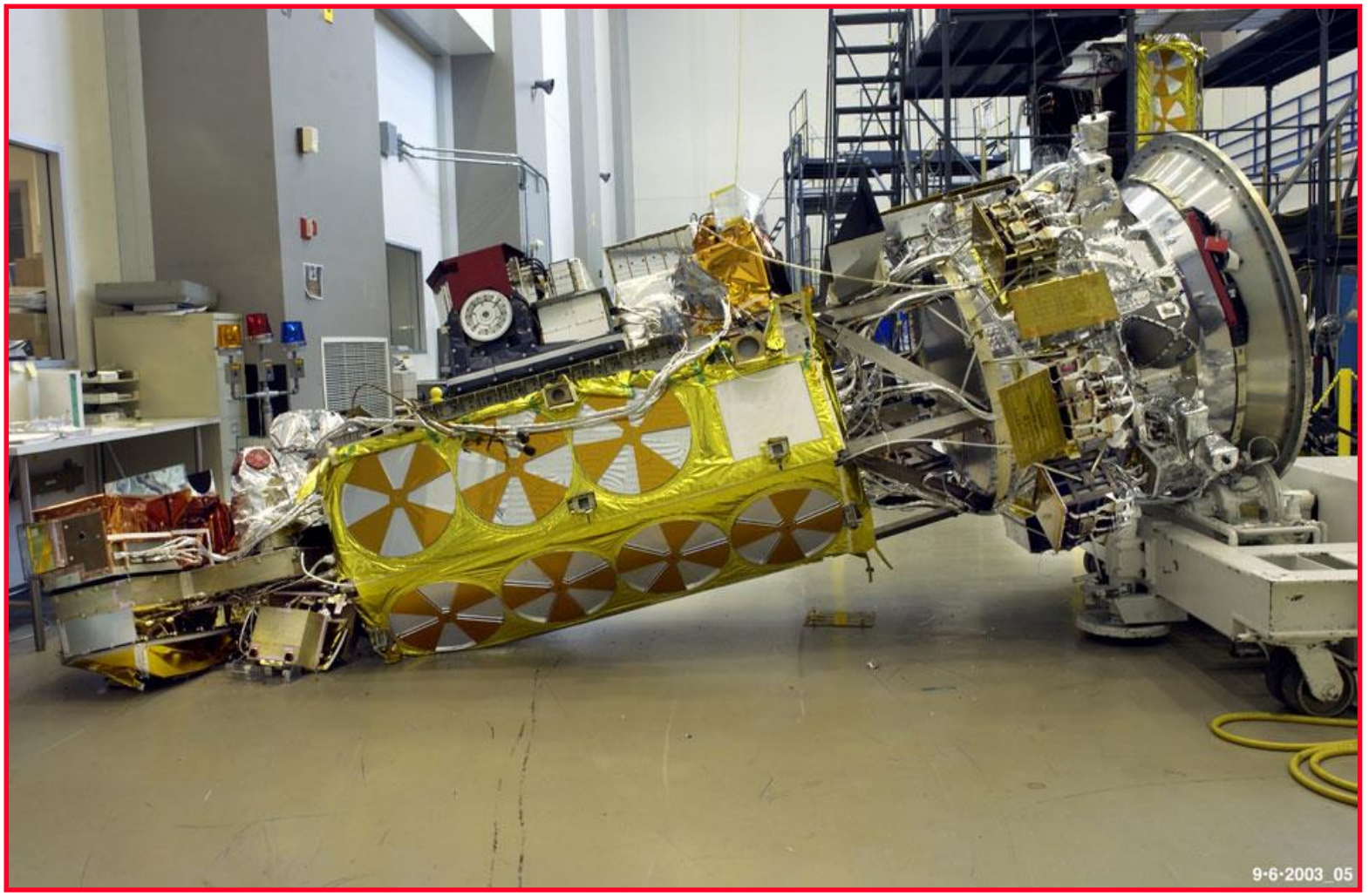
Cal Staubus



ELV Payload Safety Program

- **Purpose: To improve structure and processes for ensuring NASA ELV payloads are designed, transported, processed, tested, integrated to launch vehicle and launched safely in support of mission success.**
- **An element of OSMA**
- **Funded by OSMA via PPBE**
- **Added a Safety Manager and an Agency Team to assist when needed and provide oversight**
- **NPR 8715.7 (May 2008)**
- **Working with Air Force Ranges to tailor AFSPCMAN 91-710 for use by NASA ELV payload projects**

ELV Payload Safety Program



NOAA N-Prime

ELV Payload Safety Program

- **NPR 8715.7 *Expendable Launch Vehicle Payload Safety Program* replaced outdated NASA-STD-8719.8 *Expendable Launch Vehicle Payload Safety Review Process Standard* in May 2008**
  - **Similar PSWG safety review approach**
  - **Includes Air Force Range Safety as PSWG member**
  - **Follows NPR 7120.5 project schedule timeline**
  - **Provides more structure to the safety review process**
    - **Roles and Responsibilities defined**
    - **Deliverables better defined with a schedule**
  - **Expands beyond "pre-launch processing focus" to include design, testing, integration, launch and recovery**
  - **Helps ensure a consistent level of safety regardless of who is the project manager**

NPR 8715.7 Format

- Chapter 1:
  - Introduction
  - Payload Safety Policy
  - Programmatic Roles and Responsibilities
  - Tailoring and Waiver Processes
- Chapter 2:
  - Payload Safety Working Group
  - Project Roles and Responsibilities
  - Flow of Activities and Deliverables
  - Content of Deliverables
  - Data Submittals

New Horizons

Applicability

NPR 8715.7 Applies to:

- **Unmanned orbital and unmanned deep space payloads managed, launched, or developed in a joint venture with NASA**
- **The payload's design, fabrication, testing, vehicle integration, launch processing, launch, planned recovery, etc.**

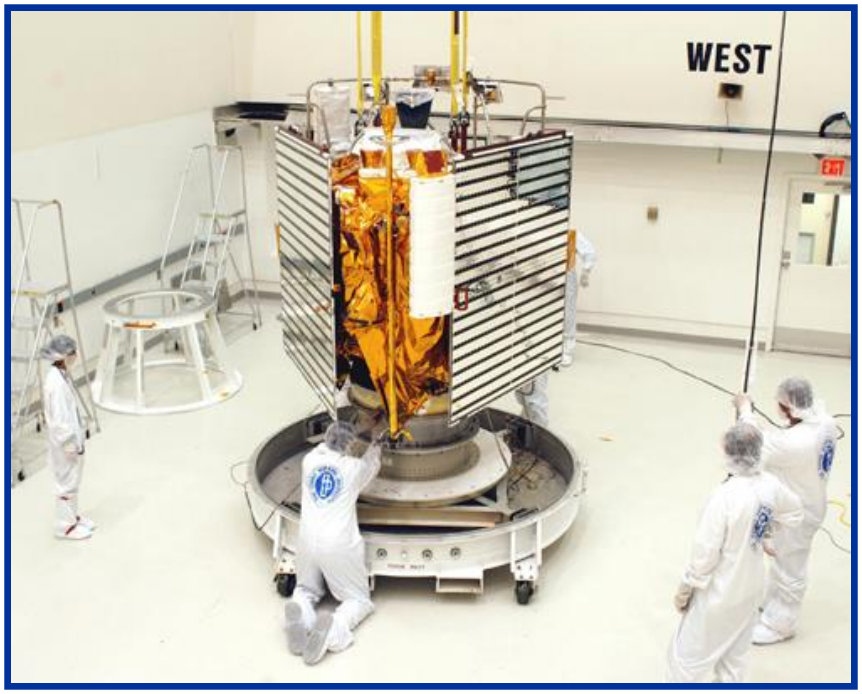
NEW HORIZONS on an ATLAS V

NPR 8715.7, paragraph P.2.b & c

Applicability (cont.)

NPR 8715.7 Does NOT Apply to:

- Payloads that interface with a manned launch vehicle or spacecraft
- Payloads that will fly on suborbital launch vehicles
- Non-NASA payloads launched from Wallops Flight Facility where NASA is just providing range services
- In-flight spacecraft operational safety or mission success

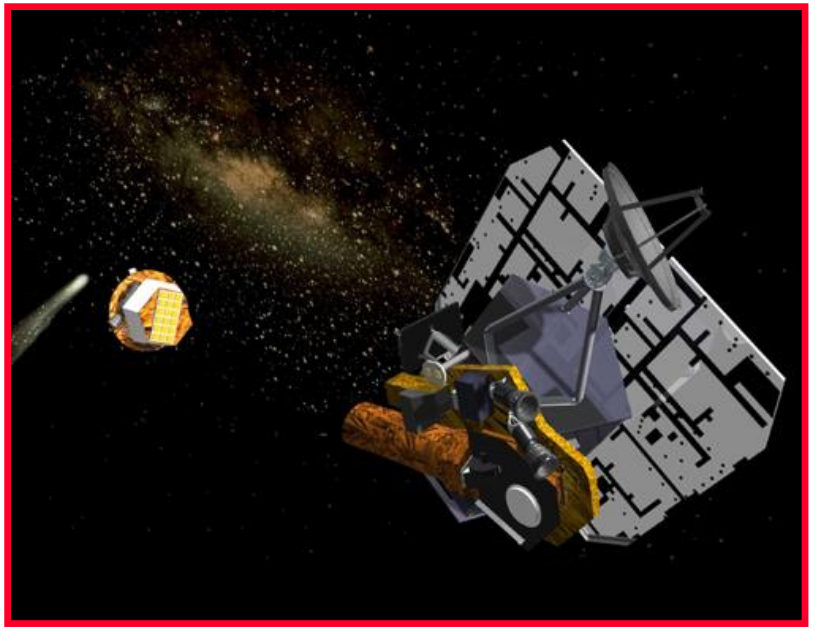


MESSENGER Assembly

NPR 8715.7, paragraph P.2.b, c, e & f

Applicability for Existing Projects

- The project must coordinate with the PSWG and ELV Payload Safety Manager for applicability of the NPR to the remainder of the project
- The level of implementation will vary based upon:
  - the project's success in complying with applicable technical safety requirements
  - the level of inherent safety risk
  - the completion of project safety milestones
  - Contract language
- <u>Pre-PDR: apply NPR fully as feasible</u>
- Existing safety-related approvals and decisions will be honored



DEEP IMPACT

NPR 8715.7, paragraph 2.3.1.n

NASA ELV Payload Safety Policy

- Safeguard people/resources from hazards by removal or reducing the risk. Accomplished by:
  - Establishment & maintenance of technical & procedural safety requirements
  - Coordination with U.S./foreign entities
  - Incorporation of safety requirements into the payload's:
    - overall requirements
    - contracts for related procurements
    - cooperative or grant agreements
  - An independent safety review & approval process
- Ensure adherence to safety requirements providing equivalent level of safety regardless of processing location

DEEP SPACE 1

NPR 8715.7, paragraph 1.2

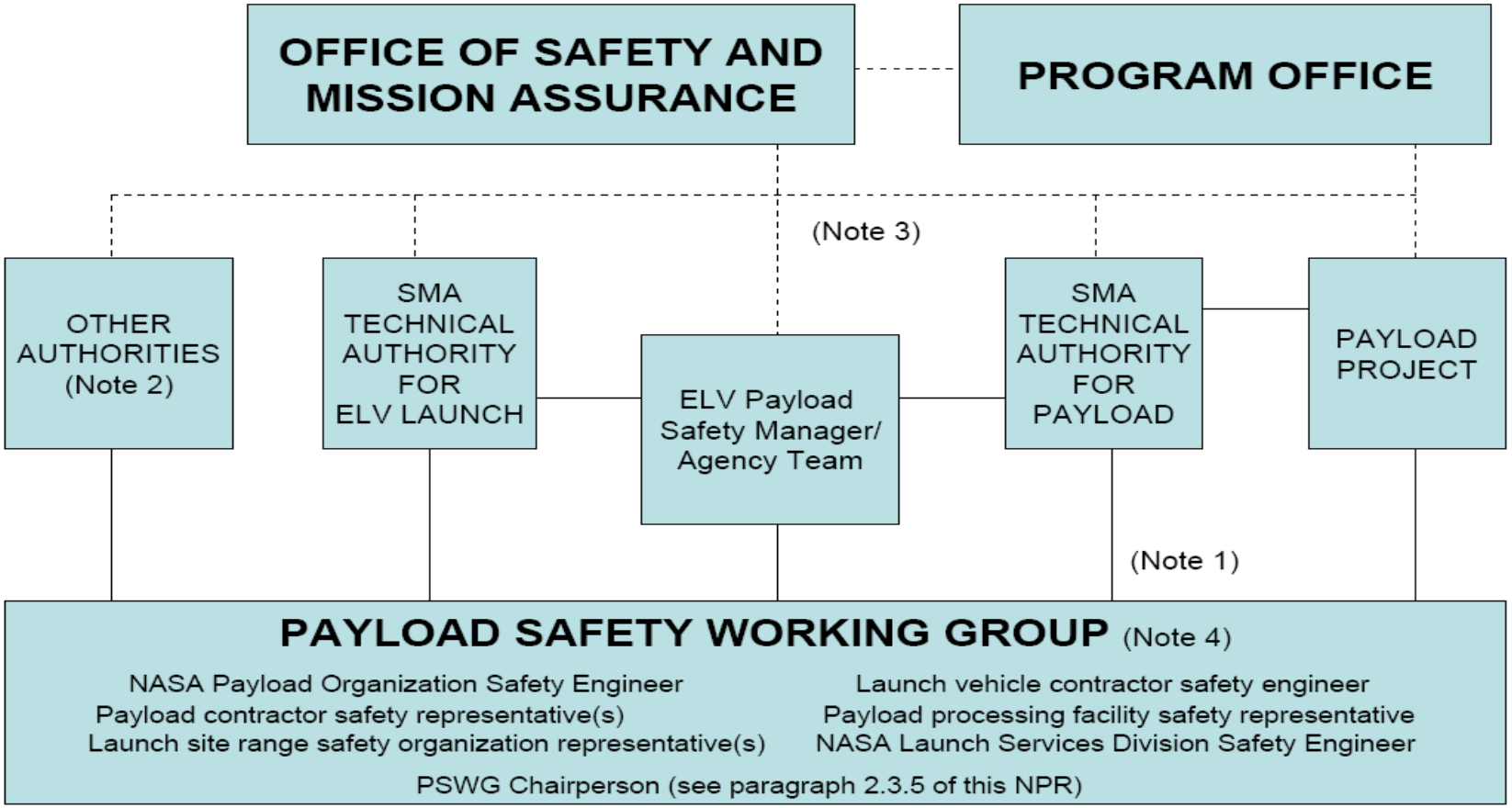
Programmatic Roles & Responsibilities

- Chief, Safety and Mission Assurance
- Each SMA Technical Authority
  - Payload Center
  - Launch processing Center, etc.
- NASA ELV Payload Safety Manager
- ELV Payload Safety Agency Team
- Each Center Director responsible for a Payload, Payload Processing Facility, or Launch Site (or designee)
- Each Center SMA Director responsible for a Payload, Payload Processing Facility, or Launch Site (or designee)
- NASA Contract, Grant, Cooperative Agreement, or Other Agreement Officers

AURORA

NPR 8715.7, paragraph 1.3.1, 2, 5 - 7

ELV Payload Safety Review Process Interfaces



Note 1: Solid lines indicate communications that take place during a nominal safety review process. The lack of lines in this figure is not to imply that communications among the various authorities can not take place.

Note 2: Other Authorities typically include the Air Force (for launches from an Air Force Range) and may include other government agencies, international partners, or commercial payload processing facilities where applicable.

Note 3: Dashed lines indicate lines of communication that may be exercised when the safety review process identifies an issue that requires a Headquarters-level decision.

Note 4: The PSWG is the primary payload safety review interface for the project, where all initial submittals and safety concerns or issues start.

NASA ELV Payload Safety Manager

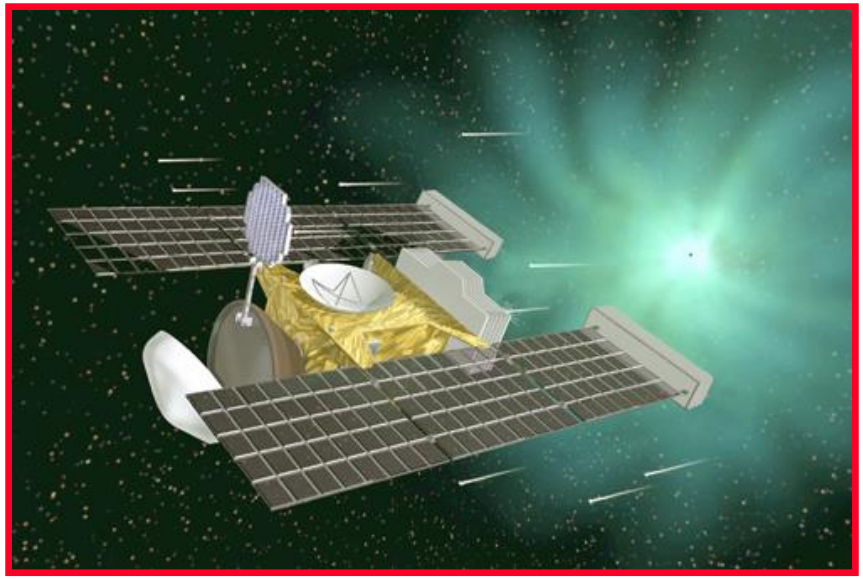
- Serves as the Agency focal point for matters of ELV payload safety
- Develops & maintains Agency-level policy & requirements as well as the safety review & approval process
- Provides input and guidance to NASA officials on contracts, grants, & cooperative agreements with internal and external entities
- Reports to the NASA HQ OSMA on safety concerns requiring an Agency-level decision
- Participate as an element of the NASA HQ SMA Audits, Reviews, and Assessments
- Opens & enhances communications with U.S. and foreign entities and document partnerships, joint activities, and special arrangements

LUNAR PROSPECTOR

NPR 8715.7, paragraph 1.3.3.a - d

ELV Payload Safety Agency Team

- An element of OSMA that functions to provide Agency-wide perspective and insight in support of the SMA Technical Authority
- Independently assess projects to assure that policy and requirements of this program are consistently implemented throughout the Agency
- Assure identification of safety concerns for each project and any applicability to other payloads
- Coordinate any safety concerns with the project's PSWG as early as possible
- Provide guidance to the Chief, Safety and Mission Assurance, and the SMA Technical Authorities, including issues requiring an Agency-level decision



STARDUST

- Assure consistent interpretation of requirements & provide guidance on implementation

NPR 8715.7, paragraph 1.3.4.a, b

ELV Payload Project Manager

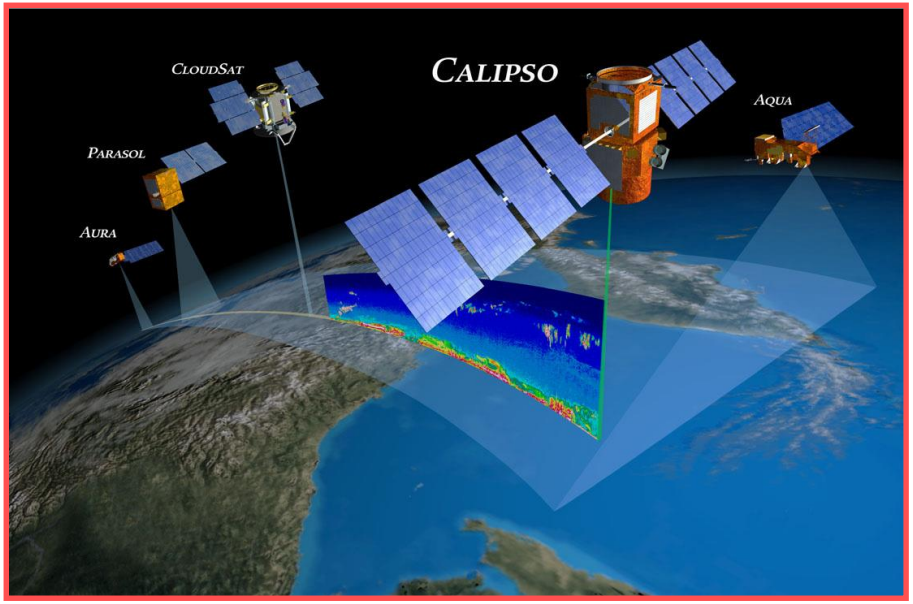
- Responsible for Project Safety
- Ensure resources are allocated to satisfy safety requirements
- Ensure that the project technical development, design, test and review processes incorporate system safety engineering
- Ensure that the design and operations of flight hardware, software, and associated GSE provides for safety through the use of approved design, analysis, and verification techniques
- Ensure the project's timeline complies with NPR 7120.5 and this safety review process

CALIPSO

NPR 8715.7, paragraph 2.3.1.a - d

ELV Payload Project Manager (cont.)

- Establish and implement any project-level processes and requirements needed to satisfy safety requirements and complete safety review and approval process
- Ensure that the project's tailored requirements document is implemented for its payload and associated GSE or a waiver is obtained
- Ensure spacecraft contractor oversight is defined, performed, and documented to enable safe integration, testing, and processing of the payload and prevention the transfer of unanticipated hazards



A-train Constellation

NPR 8715.7, paragraph 2.3.1.k - m

ELV Payload Project Manager (cont.)

- Coordinate with their local SMA for assignment of Payload Organization Safety Engineer
- Ensure the Payload Safety Introduction Briefing is coordinated and scheduled early in Phase B (as defined in NPR 7120.5)
- Notify the NASA ELV Payload Safety Manager of the new project and provide contact information for the appointed Payload Organization Safety Engineer
- Coordinate with the NASA ELV Payload Safety Manager to ensure that the project's PSWG is established and functions as required by the NPR

THEMIS at ASTROTECH

NPR 8715.7, paragraph 2.3.1.e - h

ELV Payload Project Manager (cont.)

- Ensure all project personnel involved receive training on the process, understand their roles and responsibilities, & have experience commensurate with project complexity
- Ensure that the project plans, fully participates, and supports the safety review and approval process
- Ensure safety status & any safety concerns associated with each subsystem and integrated system are presented at appropriate project reviews
- Approve all safety deliverables prior to submittal to the PSWG

PHOENIX

NPR 8715.7, paragraph 2.3.1.j, k, o, p

ELV Payload Project Manager (cont.)

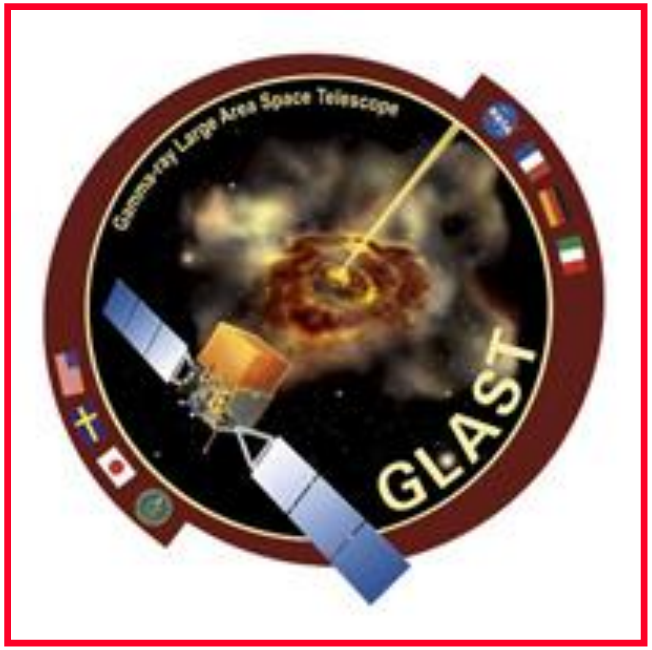
- **Obtain all safety approvals & safety readiness products needed for the project management requirements of NPR 7120.5 and accomplish mission processing.**
- ***These activities include completion of:***
  - ***Safety Review I in time to provide safety status and input to the project's Key Decision Point C***
  - ***Safety Review II in time to provide safety status and input to the project's Key Decision Point D***
  - ***Safety Review III in time to provide safety approval during the project's Pre-ship Review***

Deep Space 1

NPR 8715.7, paragraph 2.3.1.q

ELV Payload Project Manager (cont.)

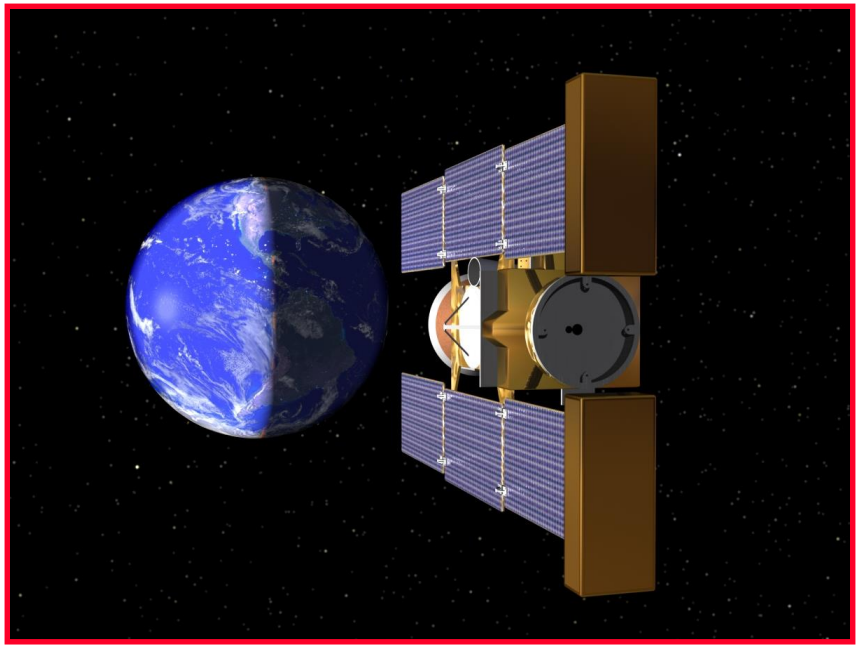
- Ensure the implementation of all safety plans & procedures required by this NPR
- Ensure that the status of any open items in the Safety Action Tracking Log or any payload safety issues that could impact launch schedule are briefed during safety and project reviews
- Ensure the design process incorporates system safety engineering activities integral to identifying hazards, developing solutions to mitigate or eliminate the hazards, and verifying the implementation of these solutions
- Ensure that the PSWG Chairperson is notified of any mishaps or close calls that take place during launch area payload processing & ground operations



NPR 8715.7, paragraph 2.3.1.r, t, b, u

ELV Payload Project Manager (cont.)

- Coordinate with the NASA ELV Payload Safety Manager and/or KSC SMA Launch Services Division Safety to ensure that the PSWG includes:
  - NASA Payload Organization Safety Engineer
  - Payload contractor safety representative(s)
  - Launch site range safety organization representative(s)
  - Launch vehicle contractor safety engineer
  - Payload processing facility safety representative
  - NASA KSC SMA Launch Services Division Safety Engineer (Chair)



Stardust Returning to Earth

NPR 8715.7, paragraph 2.3.1.i

The Payload Organization Safety Engineer

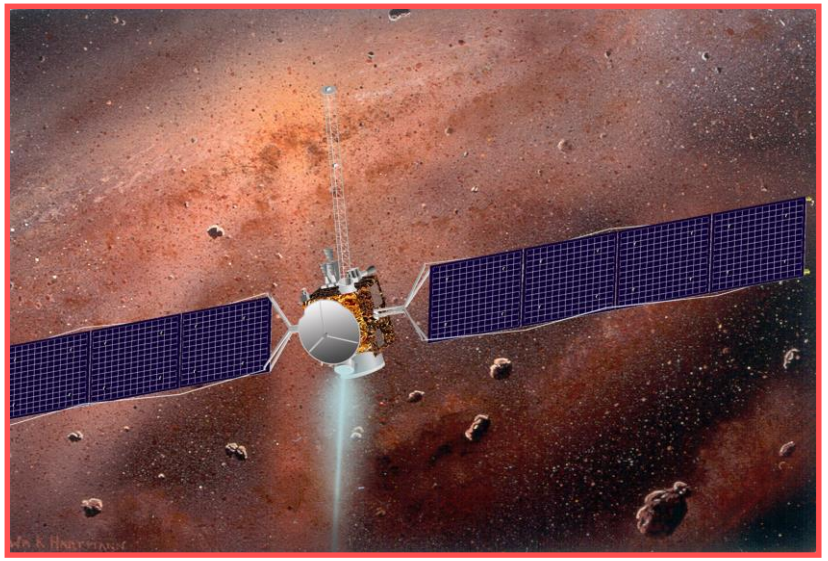
- Acts as the payload organization's primary member of the PSWG
- Ensures the preparation and submittal of all deliverables
- Keep the Payload Project Manager informed of mission safety status
- Ensures that technical operating procedures are submitted for review and approval in accordance with the safety requirements of the specific operating location
- Ensure that a Safety Verification Tracking Log (SVTL) is established, maintained and made electronically available
- Ensure that a Safety Action Tracking Log is established and maintained for the project to track closure of safety actions
- In coordination with the PSWG Chairperson, establish and maintain an integrated schedule of PWSG activities and all relevant project milestones

SORCE

NPR 8715., paragraph 2.3.1.a – c, f

PSWG Composition

- PSWG Chairperson - NASA KSC SMA Launch Services Division Safety Engineer.
- Co-Chairperson may be appointed for any mission
- Composition of the PSWG & member participation may vary based on:
  - project activities
  - technical issues
  - multi-Center project involvement
  - operational requirements e.g. selection of launch vehicle or processing facility

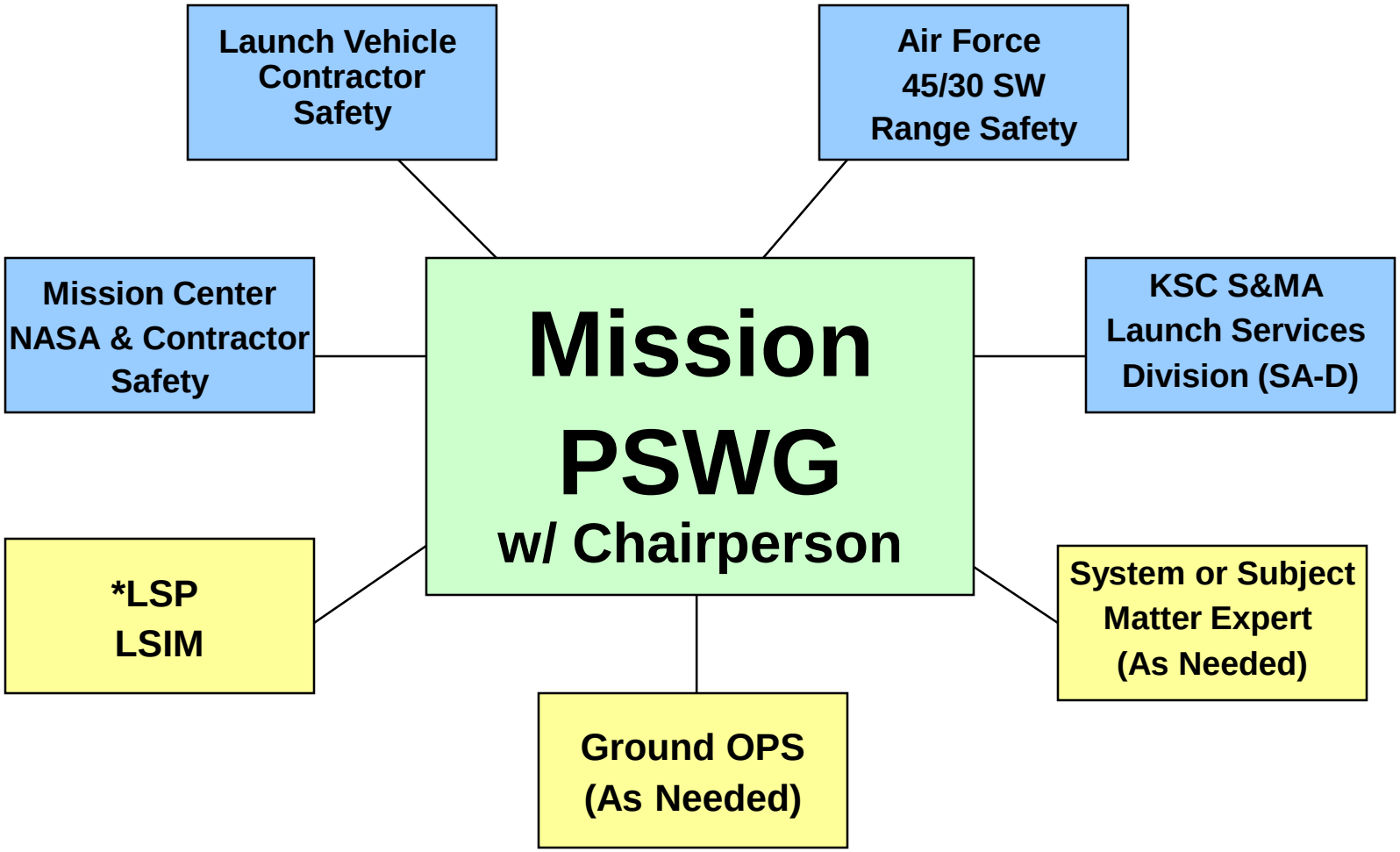


DAWN

Note: PSWG is always the starting point for resolving safety issues, then Agency Team, SMA TAs and if necessary Chief OSMA.

NPR 8715.7, paragraph 2.3.1.i.(7)

Payload Safety Working Group Membership



*Invited participant

Note: NASA Launch site safety organization will most likely chair

Each PSWG member

- Participate in the safety review and approval process
- Ensure compliance with all safety requirements for their area of responsibility and authority
- Review and provide comments to the project on deliverables within 30 days after submittal
- Assess and concur on tailoring and any waiver that is within their scope of responsibility
- Coordinate with the PSWG to resolve payload safety concerns and if needed, with the Agency Team
- Ensure that payload, facility, and payload/launch vehicle integration issues are disseminated to their organization and to other PSWG members

LRO

- Participate in PSWG activities
- Assess and concur on deliverables (plans, tailored requirements, hazard reports, Certificate of Safety Compliance, etc.)

NPR 8715.7, paragraph 2.3.3.a – f

The PSWG Chairperson

- Manage & administer PSWG activities (meetings, schedule, etc)
- Provide official PSWG signature for all deliverables and correspondence
- Ensure all comments to deliverables are organized and submitted to the project ≤ 35 days after submittal
- Ensure the Agency Team is informed of safety issues that may impede the safety review process
- If the PSWG cannot reach consensus, coordinate with the NASA ELV Payload Safety Manager to establish a resolution approach
- Ensure implementation of recommendations, interpretations, and resolutions of any safety concern provided by the Agency Team

CALIPSO

NPR 8715. 7, paragraph 2.3.4.a – f

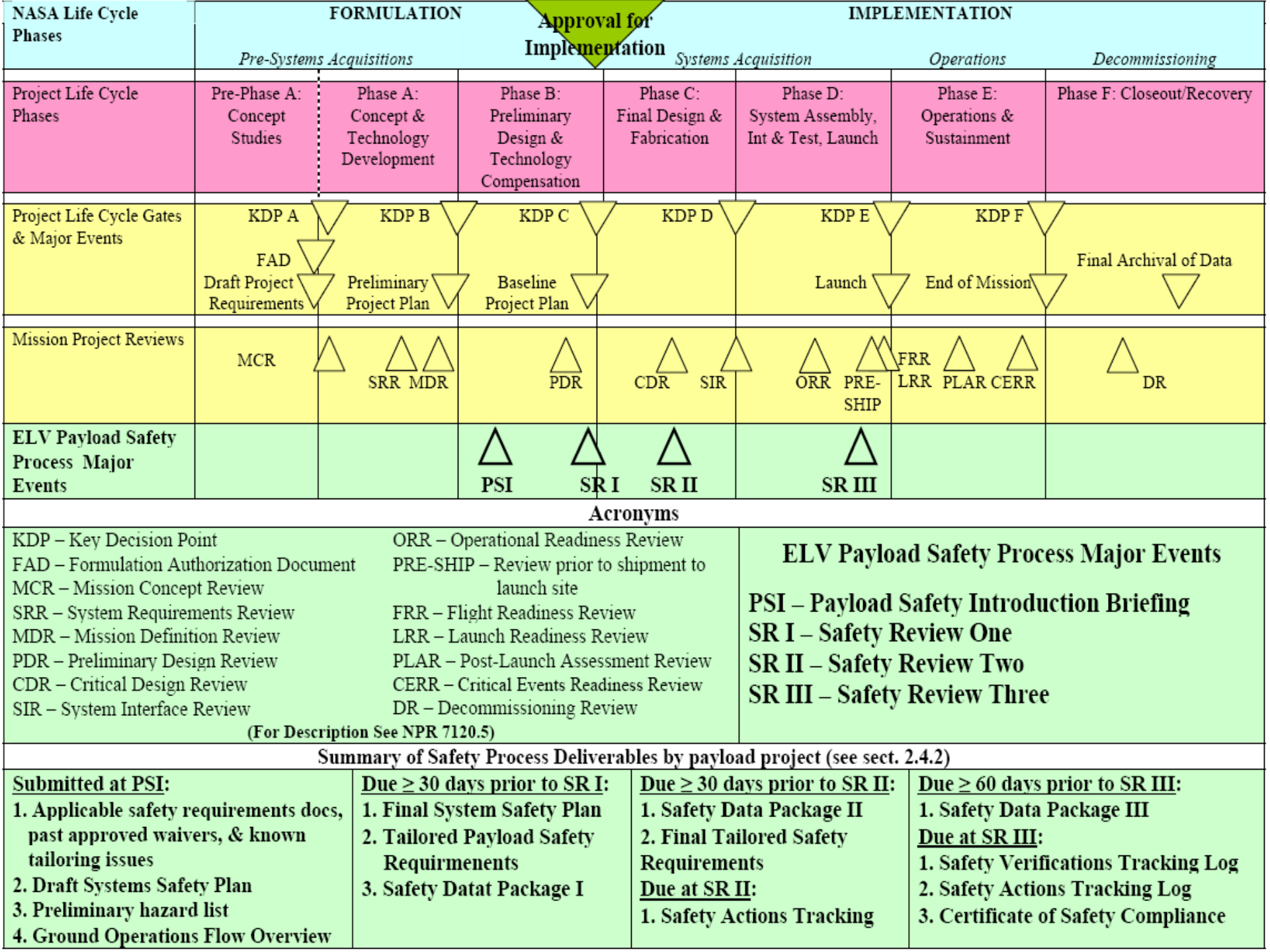
The NASA Launch Services Program Manager

- **Provide resources ensuring safety review process participation:**
  - **launch vehicle contractor (once under contract)**
  - **Launch Services SMA**
  - **USAF Range Safety**
- **Provide resources ensuring the acquisition and preparation of payload processing facilities**
- **Notify the PSWG of program meetings:**
  - **Ground Operations Working Group**
  - **Ground Operations Review**
  - **Mission Integration Working Group, and others**
- **Ensure NASA Launch Services Division Safety Representative is notified of any payload/launch vehicle interface safety concerns**
- **Ensure launch services contracts for launch vehicle and commercial payload processing facilities contain the provisions needed to satisfy the requirements of this NPR (including requirements incorporated by reference)**

GLAST

NPR 8715. 7, paragraph 2.3.5.a – e

Safety Review Process



Acronyms

KDP – Key Decision Point
FAD – Formulation Authorization Document
MCR – Mission Concept Review
SRR – System Requirements Review
MDR – Mission Definition Review
PDR – Preliminary Design Review
CDR – Critical Design Review
SIR – System Interface Review
ORR – Operational Readiness Review
PRE-SHIP – Review prior to shipment to launch site
FRR – Flight Readiness Review
LRR – Launch Readiness Review
PLAR – Post-Launch Assessment Review
CERR – Critical Events Readiness Review
DR – Decommissioning Review

(For Description See NPR 7120.5)

ELV Payload Safety Process Major Events

PSI – Payload Safety Introduction Briefing
SR I – Safety Review One
SR II – Safety Review Two
SR III – Safety Review Three

Summary of Safety Process Deliverables by payload project (see sect. 2.4.2)

Submitted at PSI:
1. Applicable safety requirements docs, past approved waivers, & known tailoring issues
2. Draft Systems Safety Plan
3. Preliminary hazard list
4. Ground Operations Flow Overview

Due ≥ 30 days prior to SR I:
1. Final System Safety Plan
2. Tailored Payload Safety Requirmenents
3. Safety Datat Package I

Due ≥ 30 days prior to SR II:
1. Safety Data Package II
2. Final Tailored Safety Requirements

Due at SR II:
1. Safety Actions Tracking

Due ≥ 60 days prior to SR III:
1. Safety Data Package III

Due at SR III:
1. Safety Verifications Tracking Log
2. Safety Actions Tracking Log
3. Certificate of Safety Compliance

A Payload Safety Introduction (PSI) Briefing

- **SCHEDULE PSI as early as possible but no later than midpoint of the Preliminary Design Phase. First meeting of the PSWG (Concept Briefing).**
- **Payload project submittals:**
  - **As a precursor to the tailoring processes, identification of the safety requirement documents that are applicable to the project; previously approved waivers and alternative approaches, and known tailoring issues**
  - **Draft Systems Safety Plan providing a conceptual overview of the Systems Safety Program**
  - **Identification of known spacecraft systems and a preliminary assessment of potential hazards documented in a preliminary hazard list**
  - **A basic Ground Operations Flow Overview providing the location and timeline of major payload activities and tasks**
- **The information provided should be as complete as the technical maturity of the conceptual design and operations allow**

Deep Impact

NPR 8715. 7, paragraph 2.4.2.a

Safety Review I

- **SCHEDULE: Begins prior to PDR & completed ≤ 60 days after PDR or as necessary ensuring PSWG's timely input to Key Decision Point C**
- **PSWG meeting in conjunction with PDR**
- **Payload project submittals due ≥ 30 days prior to the PDR meeting:**
  - **Final System Safety Plan**
  - **Tailored Payload Safety Requirements**
  - **Safety Data Package I**

DAWN

NPR 8715. 7, paragraph 2.4.2.b.(1 – 3)

Safety Review II

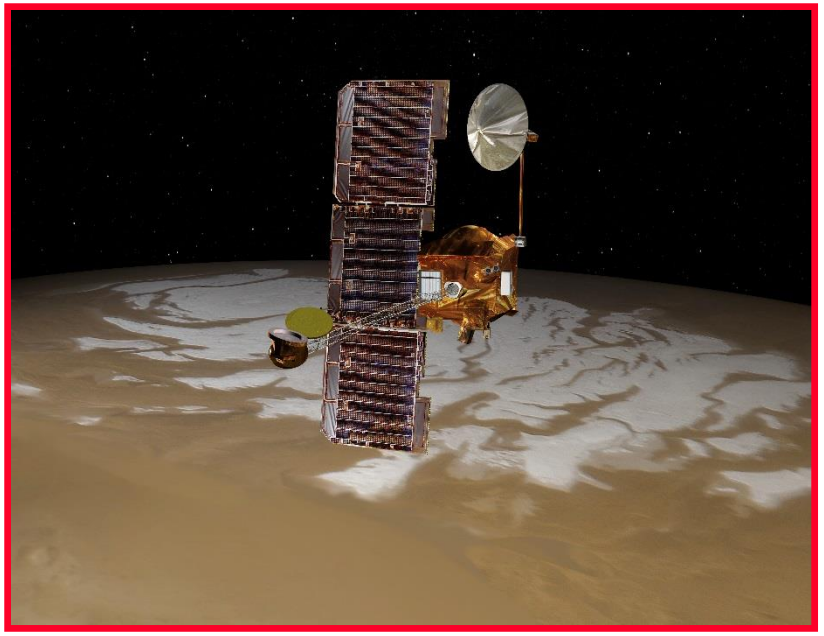
- SCHEDULE: Begins prior to CDR & completed ≤ 60 days after CDR or as necessary ensuring PSWG's timely input to Key Decision Point D
- PSWG meeting in conjunction with CDR
- Payload project submittal items due ≥ 30 days prior to the CDR meeting:
  - Safety Data Package II
  - Final Tailored Payload Safety Requirements
- Payload project submittal items due at CDR:
  - Safety Action Tracking Log for review and concurrence to close completed actions

MRO

NPR 8715. 7, paragraph 2.4.2.c.(1, 3)

Safety Review III

- **SCHEDULE: Begins with data submittal & completed at a PSWG meeting held ≥ 5 business days prior to Launch Services Program's Ground Operations Review**
- **Payload project submittals:**
  - **Safety Data Package III**
    - **Due ≥ 60 days prior to Safety Review III**
    - **Finalized ≥ 30 days before hardware shipment to processing site**
  - **Safety Action Tracking Log**
  - **Safety Verification Tracking Log**
  - **Certificate of ELV Payload Safety Compliance**



ODYSSEY over Mars' south pole

NPR 8715.X, paragraph 2.4.2.e.(1, 2)

ELV Payload Safety Certificate of Safety Compliance

CERTIFICATE OF
ELVPAYLOAD SAFETY COMPLIANCE

A. Payload Mission: _____

B. Launch Vehicle: _____

C. The Payload Project Office hereby certifies that the payload complies with all applicable requirements of NPR 8715.XX, Expendable Launch Vehicle Payload Safety Program.

D. Approved Waivers: _____

E. Payload Project Manager Signature for Approval: _____
Date: _____

F. Payload Safety Working Group (PSWG) Concurrence:

The PSWG Members concur that the necessary payload safety requirements of NPR 8715.XX and those safety requirements related to their areas of responsibility and authority are being or are planned to be satisfactorily accomplished. All compliance of safety requirements that are pending successful completion of in-line work required to support and complete this mission must be documented on the Safety Verification Tracking Log and attached.

1) NASA Payload Safety Working Group (PSWG)

Chairperson: _____ Date: _____

USAF Range Safety: _____ Date: _____

Project Safety Engineer: _____ Date: _____

Tailoring Process

- Purpose: Ensure oversight of Agency requirements and provide Centers and Project Managers with the authority and flexibility to complete their tasks.

- Definition: The process of assessing the applicability of requirements and evaluating potential compliance to generate a set of specific requirements for the project.
- The Payload Project Office (PPO) & its system safety engineer work with the PSWG to identify applicable requirements
- The PSWG Chairperson and Agency Team ensure consistency
- The PSWG Chairperson and the ELV Payload Safety Manager ensure appropriate authorities approve/sign each tailored document.

- After approval: Any changes are distributed as "change pages" by the PPO for coordination and approval/concurrence by the original authorities
- If tailoring results in an increased safety risk, the PPO shall prepare a waiver request

Deep Space

NPR 8715. 7, paragraph 1.4.1 - 5

Tailored Payload Safety Requirements

- Document all safety requirements that apply
- Baseline is AFSPCMAN 91-710, Range Safety User Requirements Manual
  - Include any applicable NASA and local safety requirements and in the event of conflicting requirements, incorporate the more stringent
- Document the applicability of safety requirements to specific situations within a mission
- Document the interpretation of requirements as needed
- Address any recommendations, interpretations, or resolutions of safety concerns provided by the Agency Team
- Identify any change to a requirement with sufficient rationale
- Identify potential areas of noncompliance
- Reference any waivers

PHOENIX

NPR 8715. 7, paragraph 2.5.2.a, b, d - i

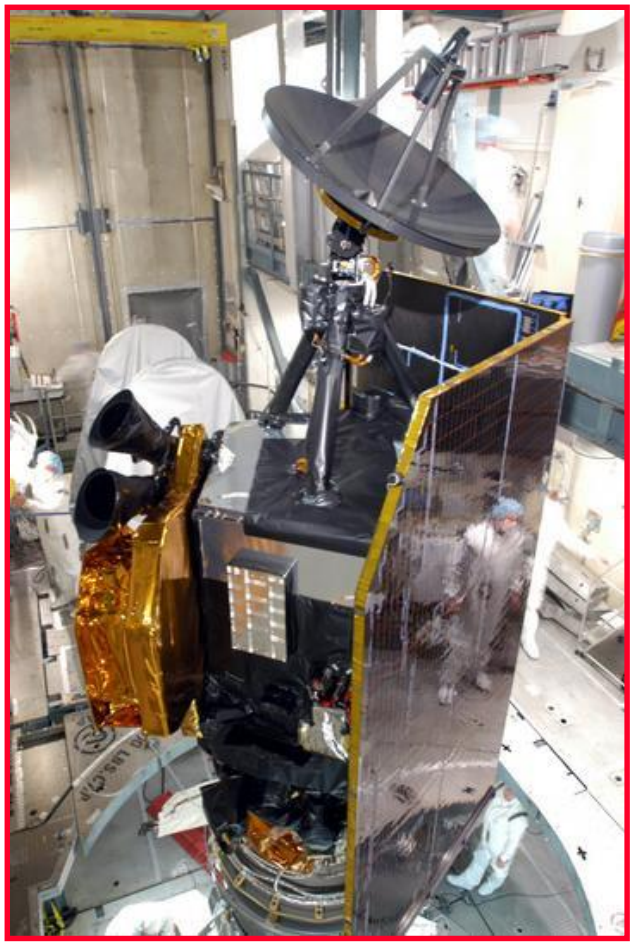
Waiver Process

- Definition: A written authorization granting relief from a requirement & documenting acceptance of associated risk
- Payload Project Manager coordinates with the PSWG when a potential non-compliance is identified and drafts waiver request
- The Payload Project Manager coordinates each request with the PSWG and Agency Team to:
  - Ensure the request and accompanying data are correct and complete
  - Ensure any risk is properly characterized and that any increase in overall risk is identified
  - Assess any effects on other projects, resources, or requirements
  - Ensure appropriate signatures for approval, concurrence, and risk acceptance per the requirements of NPR 8715.3
- In addition to satisfying NPR 8715.3, the signatories of each waiver shall include:
  - Payload Project Manager
  - Responsible NASA SMA Technical Authorities
  - Air Force Range Safety
  - All other authorities involved or responsible for issues addressed in the waiver

GOES N

Preliminary Hazard Assessments & Hazard Reports

- **Purpose: Utilize system safety engineering and analyses to identify and document potential hazards and verification for how those hazards will be eliminated or controlled**
- **At the Payload Safety Introduction Briefing, they will reflect the conceptual design, planned interfaces, operations, and identify potential hazards**
- **Hazard Reports will identify:**
  - **The hazard and mechanism for occurrence and resulting outcome**
  - **The worst case severity and probability, mitigations, and severity and probability with mitigations in-place**
- **Hazard Reports are included in each Safety Data Package**



Deep Impact

NPR 8715. 7, paragraph 2.5.5

Hazard Report Form

NASA ELV Payload Safety Hazard Report

1. Mission:					2. Hazard Report No.
3. System:	4. Hazard Description:				6. Requirement
7. Approvals					8. Rev. Date:
7a. Design Lead:		7b. I.T. Lead	7c. Safety Eng:		Originator:
7d. PA Eng:		7e. System Eng:	7f. Project Manager:		
9. Operational Phases/Facility: (Check all that apply) NASA Facility ☐ Ground Trans ☐ Pad ☐ Commercial Facility ☐			10. Risk: Initial Consequence / Initial Likelihood		Final Consequence / Final Likelihood

11. Cause	12. Control	13. Safety Verification Method	14. Verification Reference	15. Facility	16. Status

Program Website

- http://kscsma.ksc.nasa.gov/ELVPayloadSafety/default.html

- Has contact information (GSFC SMA, KSC SMA, JPL)
- References under “Requirements Documents” button
- Separate button for forms under “ELV Payload Safety Documents”

Program Website

National Aeronautics and Space Administration

Safety and Mission Assurance Directorate

+ KSC HOME | + MULTIMEDIA | + CONTACT US | + SITE SEARCH | + NASA CENTERS

- NASA Home
- KSC SMA
- GSFC SMA
- JPL Home
- Contact Us (Email)
  - Calvert Staubus
  - Shawn Donovan
- Agency Team
- Payload Safety Working Groups
- References and Documentation
- NASA Office of Safety and Mission Assurance
- NASA Engineering and Safety Center (NESC)
- Launch Services Program
- ELV Payload Monthly Calendar

ELV Payload Safety Program

+ 2007 Missions | + 2008 Missions | + Future Missions

NASA EXPENDABLE LAUNCH VEHICLE (ELV) PAYLOADS

NASA ELV payloads often incorporate hazards which can pose significant risk to life and property. **NASA ELV** payload missions require the coordination of efforts among a diverse group of participants who have varying responsibilities and authorities. These missions can present unique challenges to the payload safety assurance process, which often involves numerous organizations internal and external to the Agency. The **Office of Safety and Mission Assurance** has established the **NASA ELV Payload Safety Program** to assist ELV payload projects in obtaining the necessary safety approvals to assure that NASA safety policy is satisfied for all ELV payload missions

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